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BUFF-BURNING CLAY RESOURCES OF WESTERN ILLINOIS

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ABSTRACT

One hundred ten samples from clays occurring in the Spoon and Abbott Formations in Adams, Brown, Fulton, Hancock, Henderson, McDonough, Schuyler, and Warren Counties, Illinois,were tested to determine their potential uses. Bonding and ceramic properties were determined. The clays may be used for one or more of the following: drain tile, fillers, flower pots, flue liners, pottery, refractories, sewer pipe, stoneware, structural clay products, terra cotta, terra sigillata, and bonding clays for molding sands.

INTRODUCTION

This report on the buff-burning clay resources of western Illinois (Adams, Brown, Fulton, Hancock, Henderson, McDonough, Schuyler, and Warren Counties) is another in a series of guides to locating and developing new clay deposits that may be used in the manufacture of drain tile, flower pots, flue liners, pottery, refractories, sewer pipe, stoneware, structural clay products, terra cotta, and terra sigillata, and may be used as fillers and bonding clays. Previous reports (fig. 1) on buff-burning clay resources have been published for extreme southern Illinois, including Union, Alexander, Pulaski, Massac, Pope, Johnson, and Hardin Counties (Lamar, 1948); LaSalle County (Parham, 1959); Knox County (Parham, 1960); Rock Island, Mercer, and Henry Counties (Parham, 1961); and southwestern and southern Illinois, including Pike, Scott, Greene, Calhoun, Jersey, Madison, St. Clair, Monroe, Randolph, Jackson, Williamson, Saline, and Gallatin Counties (Parham and White, 1963).

Since most of these counties are covered by glacial deposits, exposures of the Pennsylvanian rocks are limited mainly to stream cuts, roadcuts, and mines. Many of the samples in this report were taken from beds of clay of the type that normally occur directly beneath coals. These beds of gray, fine-grained, nonlaminated

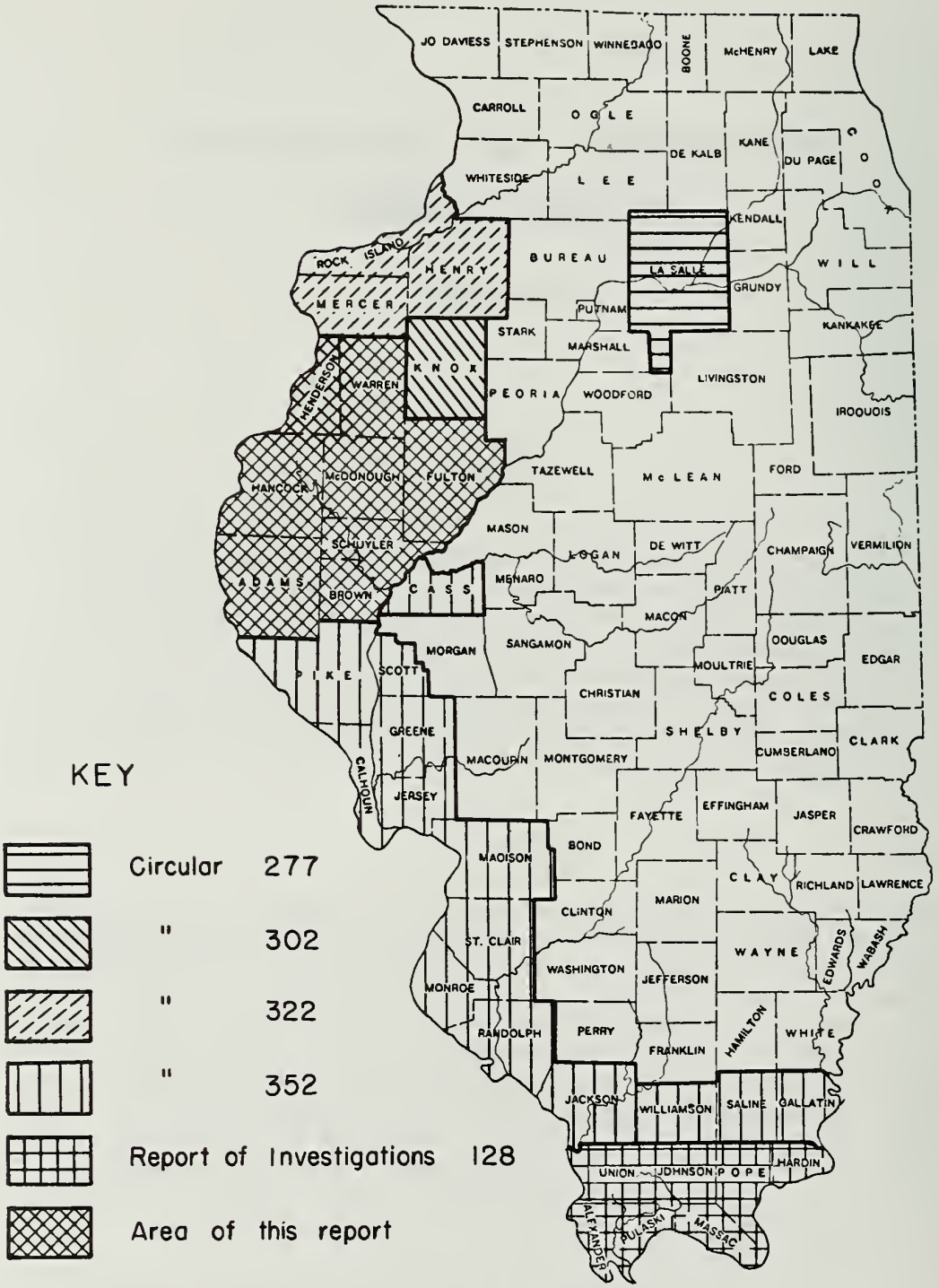

Fig. 1 - Area of this report and of previous reports describing buff-burning clay resources.

clay are called underclay and range in thickness from a few inches to about 20 feet. The remaining samples were taken from shales.

Stratigraphic Occurrence of Clay and Shale

Classification of the Pennsylvanian strata of the area of this report is indicated in figure 2 (modified from Kosanke et al., 1960). Only those members that will aid in locating the samples stratigraphically are listed. Other reports of detailed geology of the area listed in the references are Parmelee and Schroyer, 1922; Savage, 1922; Nebel, 1919; Wanless, 1957; and Kosanke et al., 1960.

Through most of this area, the Pennsylvanian rocks have a gentle regional dip to the east. The Abbott and Spoon Formations (fig. 3) thicken with the addition of new members from west to east.

In Adams, Brown, and Hancock Counties, the thickness of the Spoon and Abbott Formations ranges from a few feet to as much as 20 feet. Whereas in Fulton County the two formations may be 100 or more feet thick. The shales, limestones, sandstones, and coals are better developed in the eastern part of the area.

The clays that have most generally been used in this area occur stratigraphically between the Seahorne Limestone and the Bernadotte Sandstone. These clays have been referred to as "stoneware clays." The clays in the Abbott and Spoon Formations are buff-burning and in the western part of the area some of the shales are also buff-burning.

As is shown by the test data in table 1, the several stratigraphic units have consistent physical properties that influence their ceramic utilization. From the Abbott Formation, 8 samples were analyzed in a region from Fulton to Brown Counties. The fired color of the samples from the Abbott ranged from gray to tan but were predominently buff; linear shrinkage was generally medium. In general, the clays and shales of the Abbott Formation are suitable for the manufacture of drain tile, fillers, flower pots, flue liners, pottery, low heat duty refractories, sewer pipe, stoneware, structural clay products, and terra cotta. It is reasonable to expect that prospecting in the area of outcrop of this formation will yield commercial deposits that fall within the indicated range of properties.

From the Spoon Formation, 90 samples were analyzed in a region from Warren and Fulton Counties to Adams and Brown Counties. The fired color of the samples from the Spoon Formation ranged from gray to red but were predominently buff. Linear shrinkage was generally medium, and the P.C.E. ranged from below 20 to 30+. In general, the clays and shales of the Spoon Formation are suitable for the manufacture of drain tile, fillers, flower pots, flue liners, pottery, low and medium heat duty refractories, sewer pipe, stoneware, structural clay products, terra cotta, and terra sigillata. Commercial deposits that fall within this range of properties can probably be found by prospecting in the area of outcrop of this formation.

Nine samples from McDonough and Schuyler Counties are listed as either Abbott or Spoon Formation. The fired color of these samples ranged from white to salmon but were predominently buff; linear shrinkage was generally medium. In general, the clays are suitable for drain tile, fillers, flower pots, flue liners, pottery, low heat duty refractories, sewer pipe, stoneware, structural clay products, terra cotta, and terra sigillata.

The Carbondale clays and shales are all red-burning and can be used in the manufacture of drain tile, flower pots, pottery, sewer pipe, and structural clay products.

System	Group	Formation	Member
Pleistocene Series			
Pennsylvanian	McLeansboro	Mattoon Bond Modesto	
	Kewanee	Carbondale	Pleasantview Sandstone Purington Shale Francis Creek Shale Colchester (No. 2) Coal
		Spoon	Browning Sandstone Abingdon Coal Isabel Sandstone Greenbush Coal Wiley Coal Seahorne Limestone DeLong Coal Brush Coal Hermon Coal Seville Limestone Rock Island (No. 1)Coal
	McCormick	Abbott	Bernadotte Sandstone Pope Creek Coal Tarter Coal Manley Coal Babylon Sandstone
Mississippian			

Fig. 2 - Modified stratigraphic section.

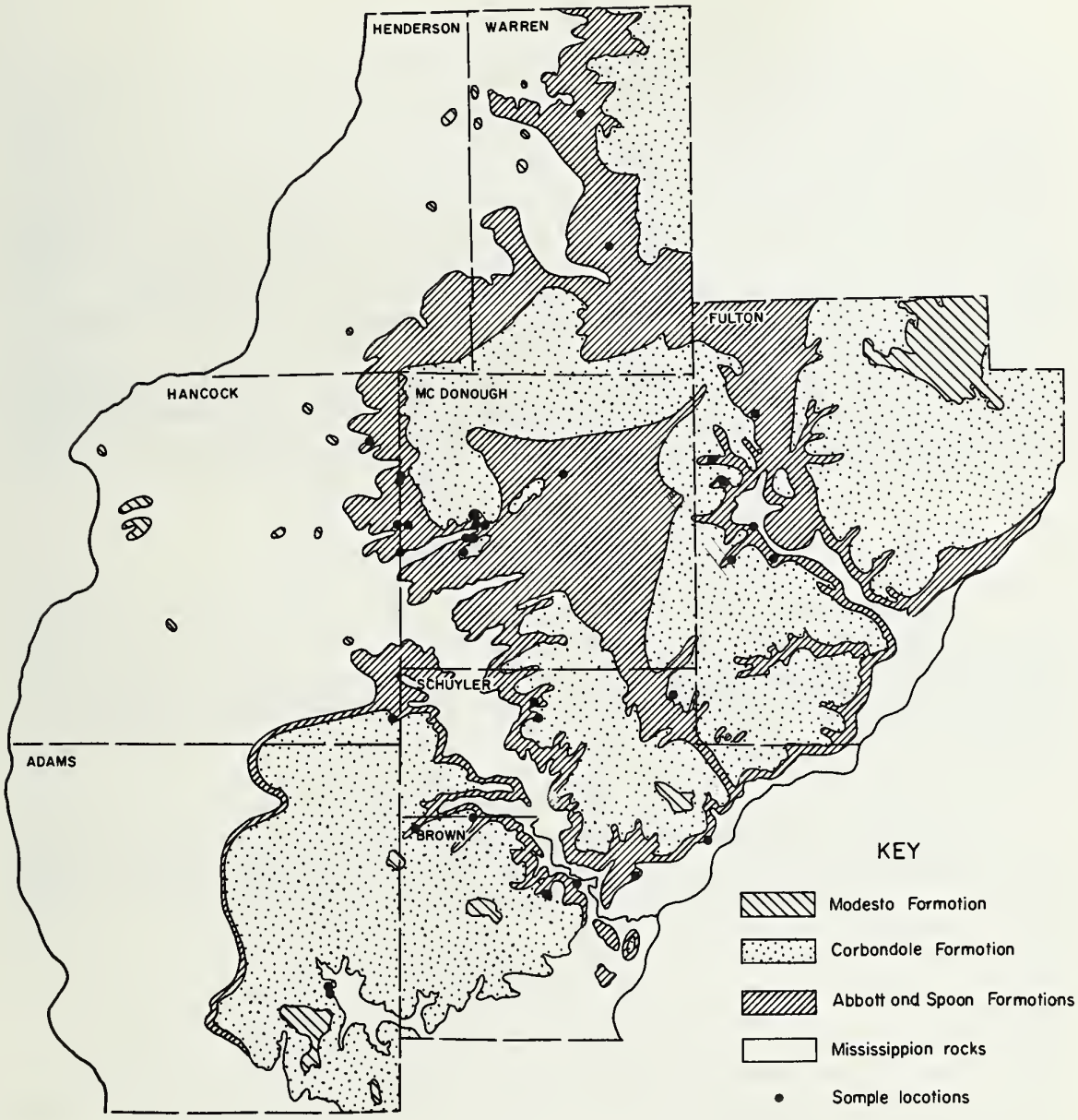

Fig. 3 - Geologic map of area studied and sample locations (after Geologic Map of Illinois, 1945).

MINERALOGY

The mineralogy was determined by x-ray, differential thermal analysis, and microscope techniques, and by megascopic observation. The clay minerals are illite, kaolinite, chlorite, and mixed-layer. The important nonclay minerals are chiefly quartz and minor amounts of pyrite, siderite, calcite, and gypsum. The quartz and pyrite occur in various concentrations in all the clays. Siderite, calcite, and gypsum occur in some of the deposits and only in small percentages. Gypsum usually occurs on, or near, the surface of the weathered clay. During weathering of pyrite in the clays, iron sulfate and sulfuric acid are formed. The sulfuric acid, in turn, may react with any calcite present, or with the calcium on the exchange positions of the clay minerals to form gypsum.

The clays and shales in the western part of the area tend to be higher in kaolinite, to be more refractory, and to burn to lighter colors than the same clays and shales in the eastern part of the area. Many of the shales that tend to burn buff in Adams and Brown Counties tend to burn red in Fulton County.

REPORT OF TESTS

Information on the formation, drying, and firing of the test bars, on high-temperature properties, and on bonding tests is given in this report. It also contains information on the sample locations, thickness of overburden, type of underlying and overlying sediments, and results of tests for the physical properties (table 1).

Test Bar Formation and Firing

The clay was ground and water was added. The mix was worked by hand to form a plastic mass. It then was stored in a humid box overnight or until it could be used. Each sample was molded into three bars, 1" × 1" × 3" or 1" × 1" × 6", the size depending on quantity of sample. Some of the bars were dried slowly under moist cloths, some in air, and some in ovens at 230°F (110°C). Defects were then recorded. Drying shrinkages were calculated from measurements of the bars before and after drying. One of the test bars of each sample was fired to 1832°F (1000°C), and another to 2012°F (1100°C). From these two firings, it was decided whether the third bar should be fired to 1922°F (1050°C) or 2200°F (1205°C). After each firing, the test bars were measured to determine the percentage of firing shrinkage and total shrinkage.

High-Temperature Properties

The refractoriness of the clay materials of Illinois tends to be controlled by the quantity of kaolinite in relation to the other minerals—the more kaolinite, the more refractory the clay material. Large quantities of quartz may increase or decrease the refractoriness of the clay material. The particle size of the quartz also may influence the refractoriness—the larger the particle size, the more refractory the clay material. Large particles leave less surface area for reaction between the clay particles and the quartz. However, a mixture of kaolinite and quartz will be less refractory than either one alone.

On the basis of mineralogical data, samples with the largest amounts of kaolinite were selected for tests to determine their fusion temperatures (pyrometric cone equivalent, P.C.E.). A small sample cone made from each clay selected was placed in a gas-fired furnace with cones of P.C.E. 28, 29, 30, and 31. The samples were heated to their fusion points. If they fused below cone 28, cones 20 through 28 were used for some of the clays. If it was estimated from the mineralogy that a clay would have a P.C.E. value of about 15, there is an X in the refractory column of table 1. Where the P.C.E. values are known, they are recorded in table 1.

The American Society for Testing Materials has classified refractory clays according to their ability to withstand heat. The refractoriness of the clay is measured in pyrometric cone equivalents (P.C.E.). A cone of clay and standard cones are heated together and the fusion is compared. When the clay melts its refractoriness is recorded as, for example, P.C.E. 30, above 30, 30-31, or below 30. The classification is (American Society for Testing Materials, 1958):

Super heat duty	P.C.E. 33 minimum
High heat duty	P.C.E. 31 minimum
Medium heat duty	P.C.E. 29 minimum
Low heat duty	P.C.E. 15 minimum

Bonding Tests

Some underclays have been found to be satisfactory for use as bonding clays in foundry sand mixes. Mixtures of 92 percent sand and 8 percent clay were made and mixed with varying amounts of water. Bonding tests then were made according to the standards set forth in the "Foundry Sand Handbook" (American Foundrymen's Society, 1952). The strengths for the various moisture contents are plotted against the moisture contents and a graph is constructed; then the maximum green compression strength (GCS) and optimum moisture are read from the graph and recorded in table 1 under bonding properties.

DEPOSITS SAMPLED

The descriptions of the deposits sampled (see appendix) are listed alphabetically by county. The sample numbers, locations, stratigraphy, lithology, and thickness of lithological unit are given for each deposit.

The deposits listed are selected from a much larger number of deposits that were sampled and tested. These deposits are representative of the clays of the area.

Refractory and buff-burning clays are most likely to be found in the area where the Abbott and Spoon Formations crop out. They may also be found by prospecting near the edge of the Carbondale, where it overlies the Spoon and Abbott Formations and where both these formations are thin and not mapped as occurring between the Carbondale and Mississippian (fig. 2). Clay deposits of the Abbott and Spoon Formations are present under the Carbondale, and they may be found by prospecting near the basal boundary of the Carbondale.

TABLE 1 - PLASTIC, FIRING, AND BONDING PROPERTIES

Sample no.	Thickness	Workability	Water of plasticity (%)	Linear drying shrinkage (%)	Firing temperatures in degrees Fahrenheit: Linear firing shrinkage (%) 1832°	2012°	2200°	Total linear shrinkage (%) 1832°	2012°	2200°	Fired color 1832°	2012°	2200°	Bonding properties: GCS (psi)	Opt.* H_2O(%)
							Adams County								
991G	4'	good	25.8	7.3	2.1	4.2	3.1	9.4	11.5	10.4	Buff	Buff	Buff	14.0	1.9
991H	4'	good	21.5	5.2	3.1	5.2	5.2	8.3	10.4	10.4	Buff	Buff	Buff	9.5	1.7
991I	4' 6"	good	22.8	6.3	1.0	3.1	5.2	7.3	9.4	11.5	Buff	Buff	Buff	6.7	1.9
991J	6'	good	23.9	6.3	0.0	4.1	6.2	6.3	10.4	12.5	Buff	Buff	Tan		
991K	1'	good	22.0	5.2	1.1	4.2	7.3	6.3	9.4	12.5	Buff	Buff	Tan		
991-O	8' 6"	good	26.5	8.3	2.1	4.2	1.1	10.4	12.5	9.4	Buff	Buff	Buff	9.3	1.5
991D	8'	good	26.8	5.2	3.1	6.3	8.3	8.3	11.5	13.5	Buff	Buff	Buff		
							Brown County								
990-O	5' 6"	good	29.8	8.3	2.1	5.5	5.5	10.4	13.8	13.8	Buff	Buff	Tan		
990P	4' 6'	good	24.4	5.2	0.0	3.1	6.3	5.2	8.3	11.5	Pink	Tan	Tan		
990Q	7'	good	22.8	4.2	0.0	4.1	5.2	4.2	8.3	9.4	Buff	Buff	Gray		
990R	3'	good	24.5	6.3	1.0	2.0	4.2	7.3	8.3	10.4	Buff	Buff	Gray		
990S	2'	good	31.9	6.3	3.1	7.2	2.0	9.4	13.5	8.3	Red	Brown	Brown		
990T	11'	fair	26.3	3.1	2.1	5.2	5.2	5.2	8.3	8.3	Buff	Buff	Buff		
990U	5'E	poor	14.9	3.1	0.0	+1.0	1.1	3.1	2.1	4.2	Buff	Buff	Buff		
990F	9' 8"E	fair	16.4	3.1	0.0	1.0	4.2	3.1	4.2	7.3	Buff	Buff	Buff		
990G	13'	fair	20.8	4.2	1.0	6.2	8.3	5.2	10.4	12.5	Buff	Buff	Tan		
990A	5'E	good	20.3	5.2	0.0	2.1	4.2	5.2	7.3	9.4	Buff	Buff	Tan		
990B	3' 6"	good	22.0	4.2	1.0	3.1	5.2	5.2	7.3	9.4	Buff	Buff	Buff		
990C	3'	good	23.6	4.2	1.0	4.1	6.2	5.2	8.3	10.4	Buff	Buff	Tan		
990DD	5'	good	22.0	5.2	1.0	2.1	4.2	6.3	7.3	9.4	Buff	Buff	Buff		
990I	9'	good	25.3	5.2	0.0	5.2	7.3	5.2	10.4	12.5	Buff	Buff	Gray		
990V	3' 2"	fair	17.4	3.1	0.0	4.2	5.8	3.1	7.3	8.9	Buff	Buff	Gray		
							Fulton County								
F72	7'E	good	23.7	6.3	0.0	2.0	7.2	6.3	8.3	13.5	Buff	Buff	Gray		
F13	18'	good	36.2	7.3	5.2	9.4	-	12.5	16.7	melted	Red	Red	-		
F4	6'	good	25.3	5.2	2.1	3.1	7.3	7.3	8.3	12.5	Salmon	Salmon	Brown		
F5	3' 6"	good	24.6	3.1	2.1	2.1	6.3	5.2	5.2	9.4	Salmon	Salmon	Red		
F6	4'	good	31.4	5.2	4.2	6.3	8.3	9.4	11.5	13.5	Salmon	Salmon	Brown		
F7	5'	good	23.2	3.1	1.1	5.2	7.3	4.2	8.3	10.4	Salmon	Red	Red		
F8	2' 6"	good	26.2	5.2	2.1	3.1	7.8	7.3	8.3	13.0	Salmon	Salmon	Brown		
F9	2' 6"	good	0.0	5.2	2.1	5.2	4.2	7.3	10.4	9.4	Salmon	Salmon	Brown		
F10	6'	good	26.3	5.2	2.1	4.2	9.4	7.3	9.4	14.6	Buff	Buff	Tan		
F11	13' 6"	good	28.4	5.2	2.1	5.2	8.3	7.3	10.4	13.5	Buff	Buff	Chocolate		
F12	2' 6"	good	23.4	5.2	0.0	1.1	5.2	5.2	6.3	10.4	Salmon	Salmon	Brown		
F116	3'	good	31.3	7.3	2.1	6.2	6.2	9.4	13.5	13.5	Salmon	Salmon	Chocolate		
F121	2'	good	28.0	7.3	3.1	7.3	8.3	10.4	14.6	15.6	Buff	Buff	Gray		
F126	1' 6"	good	26.0	6.3	2.0	5.2	7.2	8.3	11.5	13.5	Cream	Cream	Buff		

Sample no.	Suggested Uses: Drain tile	Fillers	Flower pots	Flue liners	Pottery	Refractories & ref. cements	Sewer pipe	Stoneware	Structural clay products	Terra cotta	Terra sigillata	Remarks (ox = oxidation; gd = good; drcd = drying conduct; diff = difficult)
						Adams County						
991G	X		X	X	X	P.C.E. 30+	X	X	X		X	ox, gd; drcd, gd.
991H	X		X	X	X	P.C.E. 27	X	X	X	X		ox, gd; drcd, gd.
991I	X		X	X	X	P.C.E. 30	X	X	X		X	ox, gd; drcd, gd.
991J	X	X	X	X	X	P.C.E. 28	X	X	X		X	ox, gd; drcd, gd.
991K	X		X	X	X	P.C.E. 20	X	X	X		X	ox, gd; drcd, gd; 991G through K are from the same outcrop; 991I and 991J are separated by 6 ft. of cover which could be a clay similar to the 5 samples listed; this would give 25 feet of clay.
991-O	X	X	X	X	X	P.C.E. 30+	X	X	X		X	ox, gd; drcd, gd.
991D	X	X	X	X	X	X	X	X	X		X	ox, gd; drcd, gd.
						Brown County						
990-O	X	X	X	X	X	P.C.E. 28	X	X	X		X	ox, gd; drcd, gd.
990P	X	X	X	X	X		X	X	X		X	ox, gd; drcd, gd.
990Q	X	X	X	X	X	P.C.E. 25	X	X	X	X	X	ox, gd; drcd, gd.
990R	X	X	X	X	X	X	X	X	X		X	ox, gd; drcd, gd.
990S	X		X		X		X		X			ox, gd; drcd, gd at 1922°F. Total linear shrinkage 11.5, linear firing shrinkage 5.5, and burning color red; overfired at 2200°F.
990T	X		X	X	X	X	X	X	X	X		ox, gd; drcd, gd.
990U	X		X							X		ox, gd; drcd, gd; would have to be mined with clays above 990-O through 990T; clay too sandy to use by itself.
990F	X		X			P.C.E. 20			X	X		ox, gd; drcd, gd.
990G	X	X	X	X	X	X	X	X	X		X	ox, gd; drcd, gd.
990A	X		X	X	X	P.C.E. 23	X	X	X	X		ox, gd; drcd, gd.
990B	X		X	X	X	P.C.E. 26	X	X	X	X		ox, gd; drcd, gd.
990C	X		X	X	X	P.C.E. 20	X	X	X			ox, gd; drcd, gd.
990DD	X		X	X	X	P.C.E. 23	X	X	X	X		ox, gd; drcd, gd.
990I	X	X	X	X	X	P.C.E. 30+	X	X	X		X	ox, gd; drcd, gd.
990V	X		X		X	X		X	X	X		ox, gd; drcd, gd.
						Fulton County						
F72	X	X	X	X	X	X	X	X	X			ox, gd; drcd, gd.
F13	X		X		X		X		X			ox, diff; drcd, satisfactory. Total linear shrinkage 12.0 at 1922°F; linear firing shrinkage 5.2; final color red.
F4	X		X		X		X		X			ox, gd; drcd, gd.
F5	X		X		X		X		X			ox, gd; drcd, gd.
F6	X		X		X		X		X			ox, gd; drcd, gd.
F7	X		X		X		X		X			ox, gd; drcd, gd.
F8	X		X		X		X		X			ox, gd; drcd, gd.
F9	X		X		X		X		X			ox, gd; drcd, gd; overfired at 2200°F; total firing shrinkage at 1922°F 7.3; linear final shrinkage 2.1; final color salmon.
F10	X	X	X	X	X	X	X	X	X			ox, gd; drcd, gd.
F11	X	X	X	X	X	X	X	X	X			ox, gd; drcd, gd.
F12	X		X		X		X		X			ox, gd; drcd, gd.
F116	X		X		X		X		X			ox, gd; drcd, gd.
F121		X			X	X	X	X	X		X	ox. gd; drcd, gd.
F126		X	X	X	X	X	X	X	X		X	ox, gd; drcd, gd.

TABLE 1 -

Sample no.	Thickness	Workability	Water of plasticity (%)	Linear drying shrinkage (%)	Firing temperatures in degrees Fahrenheit: Linear firing shrinkage (%) 1832°	2012°	2200°	Total linear shrinkage (%) 1832°	2012°	2200°	Fired color 1832°	2012°	2200°	Bonding properties: GCS (psi)	Opt.* H_2O(%)
					Fulton County Continued										
F129	4' 6"	good	21.2	4.2	0.0	3.1	6.2	4.2	7.3	10.4	Cream	Cream	Gray		
F130	5'	good	21.5	4.2	0.0	3.1	6.2	4.2	7.3	10.4	Cream	Buff	Gray		
F132	3'	good	22.1	4.2	0.0	3.1	6.2	4.2	7.3	10.4	Cream	Buff	Tan		
F135	2' 6"	fair	27.8	7.3	0.0	4.2	7.3	7.3	11.5	14.6	Cream	Buff	Tan		
F136	2' 6"	good	29.5	4.2	2.1	6.2	11.4	6.3	10.4	15.6	Buff	Buff	Gray		
F138	3'	fair	27.5	4.2	0.0	0.0	0.0	4.2	4.2	4.2	Buff	Buff	Buff		
F139	1' 2"	fair	25.5	6.3	0.0	0.0	5.7	6.3	6.3	12.0	Cream	Buff	Gray		
F140	1' 3"	good	26.2	5.2	0.0	3.1	6.3	5.2	8.3	11.5	Cream	Buff	Tan		
F152	3'	good	29.6	4.2	2.1	7.3	9.3	6.3	11.5	13.5	Cream	Buff	Chocolate		
F165	5'	fair	24.8	4.2	1.0	5.2	8.3	5.2	9.4	12.5	Cream	Buff	Dark Gray		
F164	1'	poor	20.1	4.2	0.0	3.1	6.2	4.2	7.3	10.4	Cream	Buff	Tan		
F163	5'	good	22.3	4.2	0.0	2.1	6.2	4.2	6.3	10.4	Cream	Buff	Tan		
F162	3' 6"	good	23.4	3.1	1.1	5.2	8.3	4.2	8.3	11.5	Cream	Buff	Gray		
F161	2' 6"	good	24.1	5.2	1.1	5.2	6.3	6.3	10.4	11.5	Salmon	Salmon	Dark Gray		
F159	6'	fair	21.1	6.3	2.0	5.2	6.7	8.3	11.5	13.0	Salmon	Red	Red		
F158	2'	good	21.0	3.1	1.1	5.2	8.4	4.2	8.3	11.5	Buff	Chocolate	Dark Gray		
F115	8'	good	28.2	4.2	2.1	3.1	11.4	6.3	7.3	15.6	Cream	Buff	Gray		
F115	4'	good	29.1	5.2	1.1	7.8	10.4	6.3	13.0	15.6	Cream	Buff	Gray		
					Hancock County										
992I	3'E	good	18.4	4.2	0.0	1.0	2.1	4.2	5.2	6.3	Buff	Buff	Buff		
992L	1'E	good	30.6	6.3	3.1	6.2	7.2	9.4	12.5	13.5	Buff	Buff	Buff		
992M	4'	good	26.6	6.3	1.0	3.1	5.2	7.3	9.4	11.5	Buff	Buff	Gray		
992H	10'	good	15.3	4.2	0.0	0.0	1.0	4.2	4.2	5.2	Buff	Buff	Buff		
992C	3' 7"	good	23.7	4.2	0.0	2.1	4.1	4.2	6.3	8.3	Red	Red	Red		
992D	6'	good	32.0	7.3	1.0	4.2	5.2	8.3	11.5	12.5	Buff	Buff	Gray		
992E	2'E	fair	21.7	4.2	2.1	3.1	6.2	6.3	7.3	10.4	Buff	Buff	Gray		
					McDonough County										
976MM	4'E	good	30.9	7.3	1.0	5.7	6.2	8.3	13.0	13.5	Cream	Cream	Gray	8.3	1.8
976GG	3'	good	22.1	6.8	0.0	1.8	3.6	6.8	8.6	10.4	Cream	Buff	Buff		
976HH	7'	good	23.9	5.7	0.6	6.8	5.8	6.3	12.5	11.5	Cream	Buff	Gray		
976A	7'	good	23.3	6.3	0.7	9.3	7.2	7.0	15.6	12.5	Buff	Buff	Tan		
976H	6'	good	24.8	6.3	1.0	3.1	5.2	7.3	9.4	11.5	Buff	Buff	Tan		
976XX	3'	good	20.7	6.3	1.0	8.3	7.2	7.3	14.6	13.5	Buff	Buff	Tan		
976YY	2' 9"	poor	21.1	2.1	2.1	6.2	8.3	4.2	8.3	10.4	Buff	Buff	Brown		
976ZZ	11"	good	35.2	8.3	3.2	8.4	-	11.5	16.7	-	Salmon	Salmon	-		
976AAA	5'	good	24.1	7.3	1.0	1.0	4.2	8.3	8.3	11.5	Buff	Buff	Tan		
976BBB	5'	good	21.6	5.2	0.0	1.1	6.3	5.2	6.3	11.5	Buff	Buff	Buff		
976CCC	7'	good	18.0	5.2	+1.0	1.1	6.3	4.2	6.3	11.5	Buff	Buff	Gray		
976DDD	10'E	fair	22.4	5.2	+1.0	1.1	6.3	4.2	6.3	11.5	Buff	Buff	Tan		
976U	6'	good	23.9	5.2	0.0	3.7	6.8	5.2	8.9	12.0	Buff	Buff	Gray		
976T	4'	good	27.6	5.2	1.1	9.4	10.4	6.3	14.6	15.6	Buff	Gray	Gray		
976SS	3'	good	20.9	5.2	+1.0	3.1	4.2	4.2	8.3	9.4	Buff	Buff	Gray		
976I	3' 5"E	good	20.9	5.2	0.0	2.1	3.1	5.2	7.3	8.3	Buff	Buff	Buff		
976WW	10'E	good	22.4	5.2	1.1	3.1	6.3	6.3	8.3	11.5	Buff	Buff	Tan		
976BB	3'	good	31.1	7.8	0.8	8.9	8.9	8.6	16.7	16.7	Buff	Buff	Gray		
976AA	3'E	good	19.2	5.7	0.6	7.3	2.6	6.3	13.0	8.3	Salmon	Salmon	Gray		
976CC	3'E	good	32.0	7.3	0.5	3.1	9.4	7.8	10.4	16.7	Red	Red	Red		
976DD	3' 6"	good	26.4	7.3	0.0	1.0	1.0	7.3	8.3	8.3	Buff	Buff	Buff		
976EE	2' 6"	good	24.4	5.2	+0.5	3.1	8.3	4.7	8.3	13.5	Buff	Buff	Gray		

Continued

Sample no.	Suggested Uses: Drain tile	Fillers	Flower pots	Flue liners	Pottery	Refractories & ref. cements	Sewer pipe	Stoneware	Structural clay products	Terra cotta	Terra sigillata	Remarks (ox = oxidation, gd = good, drcd = drying conduct, diff = difficult)
						Fulton County Continued						
F129	X	X	X	X	X	X	X	X	X			ox, gd; drcd, gd.
F130	X	X	X	X	X	X	X	X	X			ox, gd; drcd, gd.
F132		X			X	X	X	X	X			ox, gd; drcd, gd.
F135		X			X	X	X	X	X		X	ox, gd; drcd, gd.
F136		X			X	X	X	X	X		X	ox, gd; drcd, gd.
F138	X				X	X			X	X		ox, gd; drcd, gd; tendency to tear; iron scumming; need a more plastic clay added.
F139	X		X	X	X	X		X	X	X		ox, gd; drcd, gd.
F140	X		X	X	X	X	X	X	X			ox, gd; drcd, gd.
F152	X		X	X	X	X	X	X	X			ox, gd; drcd, gd.
F165	X		X	X	X	X	X	X	X			ox, gd; drcd, gd.
F164										X		ox, gd; drcd, gd; tends to tear when spatula cut off clay on top of mold; should be worked with another clay.
F163	X	X	X	X	X	X	X	X	X			ox, gd; drcd, gd.
F162	X	X	X	X	X	X	X	X	X		X	ox, gd; drcd, gd.
F161	X		X		X		X	X	X			ox, gd; drcd, gd.
F159	X		X		X		X		X			ox, diff; drcd, gd.
F158	X		X		X		X		X			ox, gd; drcd, gd.
F115	X	X	X	X	X	X	X	X	X		X	ox, gd; drcd, gd.
F115	X	X	X	X	X	X	X	X	X		X	ox, gd; drcd, gd.
						Hancock County						
992I	X		X	X	X	X	X	X	X	X		ox, gd; drcd, gd.
992L	X	X	X	X	X	X	X	X	X		X	ox, gd; drcd, gd.
992M	X	X	X	X	X	X	X	X	X			ox, gd; drcd, gd.
992H	X		X	X	X	X	X	X	X	X		ox, gd; drcd, gd.
992C	X		X		X		X		X			ox, gd; drcd, gd.
992D	X	X	X	X	X	X	X	X	X		X	ox, gd; drcd, gd.
992E	X		X	X	X	X	X	X	X			ox, gd; drcd, gd.
						McDonough County						
976MM	X	X	X	X	X	X	X	X	X		X	ox, gd; drcd, gd.
976GG	X		X	X	X	X	X	X	X			ox, gd; drcd, gd.
976HH	X	X	X	X	X	X	X	X	X		X	ox, gd; drcd, gd.
976A	X	X	X	X	X	P.C.E. 26	X	X	X		X	ox, gd; drcd, gd.
976H	X		X	X	X	X	X	X	X			ox, gd; drcd, gd.
976XX	X	X	X	X	X		X	X	X		X	ox, gd; drcd, gd; overfired at 2200°F.
976YY												ox, gd; drcd, gd; test bars contain iron and lime pops.
976ZZ												ox, diff; drcd, some cracking: lime pop.
976AAA	X		X	X	X	X	X	X	X			ox, gd; drcd, gd.
976BBB	X		X	X	X	X	X	X	X			ox, gd; drcd, gd.
976CCC	X		X	X	X	X	X	X	X			ox, gd; drcd, gd.
976DDD	X		X	X	X	X	X	X	X			ox, gd; drcd, gd.
976U	X		X	X	X	X	X	X	X		X	ox, gd; drcd, gd.
976T	X	X	X	X	X	X	X	X	X		X	ox, gd; drcd, gd; iron scum.
976SS	X		X	X	X	X	X	X	X	X		ox, gd; drcd, gd.
976I	X		X	X	X	X	X	X	X	X		ox, gd; drcd, gd.
976WW	X		X	X	X	X	X	X	X			ox, gd; drcd, gd.
976BB		X			X	X	X	X			X	ox, gd; drcd, gd.
976AA	X		X		X		X		X			ox, gd. drcd, gd; overfired at 2200°F.
976CC	X		X		X		X		X			ox, gd; drcd, gd.
976DD	X		X	X	X	X	X	X	X	X		ox, gd; drcd, gd.
976EE	X		X	X	X	X	X	X	X			ox, gd; drcd, gd.

TABLE 1 -

Sample no.	Thickness	Workability	Water of plasticity (%)	Linear drying shrinkage (%)	Firing temperatures in degrees Fahrenheit: Linear firing shrinkage (%) 1832°	2012°	2200°	Total linear shrinkage (%) 1832°	2012°	2200°	Fired color 1832°	2012°	2200°	Bonding properties: GCS (psi)	Opt.* H_2O(%)
							Schuyler County								
978C	3'	good	20.3	4.7	0.0	0.5	1.6	4.7	5.2	6.3	Buff	Buff	Buff		
978D	2'	good	23.7	4.7	+0.5	0.5	3.7	4.2	5.2	8.3	Buff	Buff	Tan		
978E	4'	good	23.5	5.2	0.0	2.1	6.3	5.2	7.3	11.5	Buff	Buff	Tan		
978F	4' 6"	good	21.9	4.2	0.0	2.6	3.1	4.2	6.8	7.3	Buff	Buff	Buff		
978G	5' 6"	fair	21.7	5.2	0.0	0.0	3.1	5.2	5.2	8.3	Buff	Buff	Buff		
978H	3'	fair	20.0	4.2	+0.5	0.5	1.5	3.7	4.7	5.7	Buff	Buff	Buff		
978I	7'E	good	28.8	5.2	+0.5	0.0	–	4.7	5.2	–	Buff	Buff	–		
978J	2' 5"	good	28.1	5.7	1.1	4.7	5.8	6.8	10.4	11.5	Buff	Buff	Buff		
978K	2'	good	25.0	6.3	0.5	1.0	5.2	6.8	7.3	11.5	Buff	Buff	Buff		
978L	2'	good	24.0	3.7	1.0	4.6	5.7	4.7	8.3	9.4	Buff	Buff	Buff		
978M	3'	good	28.4	5.2	1.1	4.7	6.3	6.3	9.9	11.5	Buff	Buff	Buff		
978GG	5' 6"	poor	25.9	3.1	0.0	–	–	3.1	–	–	Salmon	–	–		
978HH	2' 6"	good	31.3	7.0	1.9	3.4	5.5	8.9	10.4	12.5	Buff	Buff	Buff		
978II	6'	good	20.8	4.7	+0.8	1.6	4.1	3.9	6.3	8.8	Buff	Buff	Buff		
978JJ	7'	good	23.8	4.7	+1.6	+1.1	3.6	3.1	3.6	8.3	Buff	Buff	Buff		
978KK	1' 6"	good	35.4	6.3	0.3	5.2	6.2	6.6	11.5	12.5	White	White	White		
978FFF	5'	good	24.0	5.2	1.1	3.1	5.2	6.3	8.3	10.4	Buff	Buff	Buff		
							Warren County								
977D	1' 6"	good	30.2	5.2	1.6	8.2	10.5	6.8	13.4	15.7	Buff	Buff	Tan		
977C	4'	fair	35.1	4.2	2.1	8.3	10.4	6.3	12.5	14.6	Salmon	Salmon	Red		
977B	2' 4"	good	33.5	6.3	2.0	6.2	6.2	8.3	12.5	12.5	Buff	Buff	Chocolate		
977A	3' 6"	good	21.7	5.7	+0.5	1.6	4.2	5.2	7.3	9.9	Buff	Buff	Buff		
977E	3'	good	24.3	4.7	0.5	4.7	8.8	5.2	9.4	13.5	Cream	Buff	Gray		
977F	1' 6"	good	24.9	4.7	+0.5	4.7	7.8	4.2	9.4	12.5	Cream	Buff	Gray		
977G	1' 6"	good	34.2	6.3	1.5	6.2	10.4	7.8	12.5	16.7	Buff	Buff	Chocolate		
977H	1' 6"	good	34.0	7.3	2.2	8.3	11.5	9.4	15.6	18.8	Salmon	Salmon	Red		
977I	1'	good	36.1	8.3	3.7	–	7.3	12.0	–	15.6	Salmon	–	Red		
977J	1' 6"E	good	30.9	6.8	0.5	4.7	8.8	7.3	11.5	15.6	Cream	Buff	Gray		

* Optimum water content for maximum strength.

Continued

Sample no.	Suggested Uses: Drain tile	Fillers	Flower pots	Flue liners	Pottery	Refractories & ref. cements	Sewer pipe	Stoneware	Structural clay products	Terra cotta	Terra sigillata	Remarks (ox = oxidation; gd = good; drcd = drying conduct; diff = difficult)
						Schuyler County						
978C	X		X	X	X	X	X	X	X	X		ox, gd; drcd, gd.
978D	X		X	X	X	X	X	X	X	X		ox, gd; drcd, gd.
978E	X		X	X	X	X	X	X	X			ox, gd; drcd, gd.
978F	X		X	X	X	X	X	X	X	X		ox, gd; drcd, gd.
978G	X		X	X	X	X	X	X	X	X		ox, gd; drcd, gd.
978H	X		X	X	X	X	X	X	X	X		ox, gd; drcd, gd.
978I	X		X	X	X	X	X	X	X	X		ox, gd; drcd, gd.
978J	X		X	X	X	X	X	X	X			ox, gd; drcd, gd; calcareous; no lime pops observed.
978K	X		X	X	X	X	X	X	X			ox, gd; drcd, gd.
978L	X		X	X	X	X	X	X	X	X		ox, gd; drcd, gd.
978M	X		X	X	X	X	X	X	X			ox, gd; drcd, gd.
978GG												ox, gd; drcd, gd; very sandy; should be used with more plastic clays.
978HH	X		X	X	X	X	X	X	X			ox, gd; drcd, gd.
978II	X		X	X	X	X	X	X	X	X		ox, gd; drcd, gd; iron scum.
978JJ	X		X	X	X	X	X	X	X	X		ox, gd; drcd, gd.
978KK	X		X	X	X	X	X	X	X		X	ox, gd; drcd, gd; could be used for china.
978FFF	X		X	X	X	X	X	X	X			ox, gd; drcd, gd.
						Warren County						
977D	X	X	X	X	X	X	X	X	X		X	ox, gd; drcd, gd.
977C	X		X				X		X			ox, fair; drcd, gd.
977B	X		X	X	X		X	X	X			ox, gd; drcd, gd.
977A	X		X	X	X	X	X	X	X	X		ox, gd; drcd, gd.
977E	X	X	X	X	X	X	X	X	X		X	ox, gd; drcd, gd.
977F	X	X	X	X	X	X	X	X	X		X	ox, gd; drcd, gd.
977G	X		X	X	X	X	X	X	X			ox, gd; drcd, gd.
977H					X		X					ox, gd; drcd, could be diff.
977I					X		X					ox, gd; drcd, could be diff; bonding properties-GCS 10.8, optimum water 1.9.
977J	X	X	X	X	X	X	X	X	X		X	ox, gd; drcd, gd.

APPENDIX

DESCRIPTION OF DEPOSITS SAMPLED

	Thickness (Ft. In.)

ADAMS COUNTY

Samples 991G, H, I, J, and K - West cutbank of Coal Creek, NE¼ SW¼ NE¼ sec. 18, T. 2 S., R. 5 W.

Pleistocene Series		
Loess and till	40±	
Pennsylvanian System		
Carbondale Formation		
Shale, light gray	3±	
Shale, black, fissile	1	6
Colchester (No. 2) Coal	1	
Spoon Formation		
Underclay, dark gray (sample 991G)	2	
Clay, gray, iron stained on joints (sample 991G)	2	
Clay, gray, iron stained on joints (sample 991H)	4	
Limestone and calcareous clay; contains selenite crystals (Seahorne)		6
Clay, light gray, blocky (sample 991I)	4	
Covered interval	6	
Clay, dark gray (sample 991J)	6	
Clay, light gray, sandy (sample 991K)	1	
Sandstone, light gray, iron stained, argillaceous (sample 991K) (exposed)	1	

Sample 991 O - Southwest bank of Coal Creek in in N½ SE¼ SE¼ sec. 18, T. 2 S., R. 5 W.

Pleistocene Series		
Loess and till	20	
Pennsylvanian System		
Carbondale Formation		
Shale (Francis Creek), gray	20	
Colchester (No. 2) Coal	1	7
Spoon Formation		
Clay, medium gray, somewhat laminated; contains dark carbonaceous streaks (sample 991 O)		9½
Clay, light gray, blocky fractured; contains selenite crystals (sample 991 O)	1	7
Clay, light gray with darker gray masses (sample 991 O)	1	
Clay, light gray, blocky, iron stained on joint surfaces (sample 991 O)	1	6
Clay, light gray, iron stained; contains limestone nodules (Seahorne) (sample 991 O)		8-12
Clay, gray, hard, blocky, sandy (exposed) (sample 991 O)	3	
Covered interval	2	6
Abbott Formation		
Sandstone, yellow-gray, medium grained; very uneven knobby surface; recrystallized grains; shows indistinct root traces (exposed)	8	

BROWN COUNTY

Samples 990 O, P, Q, R, S, T, and U - North of road in north valley wall in NE¼ SE¼ SE¼ sec. 1, T. 1 N., R. 4 W.

Pleistocene Series		
Loess and till	15	
Pennsylvanian System		
Spoon Formation		
Limestone (Seahorne), gray	2	
Clay, gray, variegated yellow-purple (sample 990 O)	5	6
Clay, greenish gray (sample 990P)	4	6
Sandstone		4
Clay, mottled light and dark gray (sample 990Q)	2	6
Clay, light gray (sample 990Q)	3	
Clay, gray, sandy (sample 990Q)	1	6
Clay-shale, dark gray (position of Hermon Coal?)		3
Clay, gray, sandy, calcareous at base (sample 990R)	3	
Limestone (Seville), brick red	1	
Shale, brown (sample 990S)	2	
Shale, gray, poorly laminated (sample 990T)	11	
Abbott Formation (?)		
Sandstone (Bernadotte?), light gray, argillaceous (sample (990U) (exposed)	5	

Samples 990F and G - South side of creek in NW¼ NE¼ NE¼ sec. 1, T. 1 S., R. 3 W.

Covered		
Till, loess, slumped coal, and shale	15±	
Pennsylvanian System		
Spoon Formation		
Clay, gray (sample 990G)	3	
Limestone (Seahorne), blue-gray	4-5	
Clay, gray (sample 990G)	10	2
Coal		2
Clay, gray (sample 990F) (exposed)	9	8

Sample 990A - East of cemetery and hard road south of Ripley at junction of ravines from south and west in NW¼ SE¼ SW¼ sec. 33, T. 1 N., R. 2 W.

Pleistocene Series		
Loess and till	25	

(BROWN COUNTY Cont.)

	Thickness (Ft. In.)
Pennsylvanian System	
Spoon Formation	
Clay, black	1
Siltstone, gray	6
Shale, light gray (sample 990A)	3 6
Ironstone, calcareous	3
Shale, light gray (sample 990A) (exposed)	1 6
Samples 990B, C, and D - Down stream from sample 990A in NE¼ NE¼ SW¼ sec. 33, T. 1 N., R. 2 W.	
Pleistocene Series	
Loess and till	25
Pennsylvanian System	
Spoon Formation	
Clay, gray, weathered (sample 990D)	3
Clay, dark gray (coal horizon) (sample 990D)	3
Underclay; grades into gray shale (sample 990D)	2
Shale, light gray (sample 990C)	3
Rock Island (No. 1) Coal (?), weathered	7
Underclay, gray (sample 990B)	3
Abbott Formation (?)	
Sandstone (exposed)	3
Sample 990I - Road cut in center NE¼ NW¼ sec. 29, T. 1 S., R. 1 W.	
Pleistocene Series	
Loess and till	60±
Pennsylvanian System	
Carbondale Formation	
Shale, gray, fossiliferous (exposed)	2
Shale, black; contains calcareous ironstone concretion layer at top	3
Shale, gray	3
Limestone	3
Shale, dark gray	1
Shale, black fissile	1
Shale, gray	6
Colchester (No. 2) Coal	2 5
Spoon Formation	
Clay, yellowish gray	6
Limestone (Seahorne), blue-gray, knobby	3
Clay, gray (sample 990I)	3
Limestone	6
Clay, gray (sample 990I)	3
Sandstone, light brownish gray, fine grained	6
Shale, light gray, poorly bedded (sample 990I)	1
Sandstone, red and light gray mottled, calcareous, weathered	1 6
Clay, gray (sample 990I)	1
Limestone, red, fossiliferous, calcareous	8
Covered to river	40±
Sample 990V - Along east bank of Little Missouri Creek in NE¼ NW¼ NW¼ sec. 8, T. 1 N., R. 4 W.	
Pleistocene Series	
Loess and till	20
Pennsylvanian System	
Carbondale Formation	
Shale, light gray, slightly silty; contains a few small ironstone concretions	40
Colchester (No. 2) Coal, poorly exposed	2 6
Spoon Formation	
Clay, partly covered	2 6
Limestone (Seahorne), light gray, somewhat conglomeritic, fossiliferous, nodular, dense; knobby upper surface	2 6
Covered interval	5
Clay, light gray, plastic, noncalcareous	1
Clay, calcareous	¼
Clay, dark gray to black, coaly	½
Clay, light blue-gray, non-calcareous	3
Clay, light gray, shaly	1 8
Clay, rust-brown to olive-gray	3
Clay, dark gray (coal zone)	2
Sandstone, dark gray, not well bedded	5
Sandstone, gray, sugary, massive, hard	3 5
Shale, blue-gray, thin bedded, flaky, noncalcareous; contains lenses of white to light gray sandstone throughout (sample 990V)	3 2
Shale, dark gray	0-2
Sandstone, fairly coarse grained, bluish gray in upper portion, rust-brown below, poorly bedded	10
Shale, blue-gray, evenly bedded, nongritty, flaky	7
Clay, light brownish gray, not well bedded	1
Sandstone, light purplish gray, medium grained, not well bedded (exposed)	4

FULTON COUNTY

Sample F72 - First short ravine south of Aylesworth Branch on west side of Spoon River in the NE¼ NE¼ sec. 14, T. 7 N., R. 1 E.	
Pleistocene Series	
Loess and till	
Pennsylvanian System	
Spoon Formation	

(FULTON COUNTY Cont.)

	Thickness (Ft. No.)
Clay, thin, coaly	½-1
Clay or shale, poorly exposed	3±
Wiley Coal	1 2
Clay, blue-gray, poorly exposed	2 10
Limestone (Seahorne), concretionary, septarian, not well exposed	½-1
Clay, gray, poorly exposed	1
Covered interval	3-4
Clay, blue-gray (sample F72)	6-8
Covered interval	3±
Rock Island (No. 1) Coal (?), neither top nor base seen	2 6
Covered interval	3±
Clay, light gray	2-3
Covered interval	3±
Clay, light gray	2
Shale, gray to dark gray	1½-2
Abbott Formation	
Sandstone; large massive blocks	3±
Covered interval	3-4
Clay, gray	1-2
Shale, blue-gray	3 6
Sandstone, hard, in bed of stream	1-2
Coal	8
Covered interval	2
Clay, gray	1
Covered interval	5-6
Level of Spoon River	

Samples F13, F4, F5, F6, F7, F8, F9, F10, F11, and F12 - Road cut west of railroad in SE¼ NE¼ SE¼ sec. 22, T. 6 N., R. 1 E.

Pleistocene Series	
Loess and till	
Carbondale Formation	
Shale (Francis Creek), gray to olive-gray, soft (sample F13) (exposed)	18
Colchester (No. 2) Coal	1 11
Spoon Formation	
Clay, light gray, slightly rusty brown along joint surfaces in lower part	2 2
Clay, brownish gray, harder than above, more calcareous towards base; selenite crystals along base (sample F4)	1-2
Clay, slightly sandy, pinkish, calcareous	3
Clay, olive-gray, sandy, indistinctly laminated; grades down into well-laminated slightly sandy shale	2
Shale, olive-gray (samples F5 and F6)	7 6
Shale, dark blue-gray to black, slightly fissile	9
Clay, dark gray	4
Clay, light gray; contains carbonaceous streaks; lower part rusty brown, somewhat sandy; contains calcareous concretions; not well exposed (sample F7)	5
Shale, dark gray to bluish gray	6
Clay, light gray, rusty brown and darker near base, very slightly sandy; blocky structure (sample F8)	2 6
Wiley Coal	10
Clay, dark gray, slightly yellow on fracuture surfaces	4
Clay, light gray, very rusty brown on fracture surfaces (sample F9)	8
Clay, light gray, slightly rusty brown on fracture surfaces	1-2
Clay, gray, sandy near middle (sample F10)	5-6
Clay, dark brownish gray	10
Clay, dark gray, carbonaceous	1½
Clay, brownish gray	3
Clay, light gray, rusty brown on fracture surfaces (sample F11)	3
Clay, light gray (sample F11)	5
Clay, dark blue-gray, slightly rusty on fracture surfaces (sample F11)	9
Clay or shale, dark gray, carbonaceous (sample F11)	1
Clay, dark gray, lighter than above (sample F11)	4
Clay, light gray, slightly rusty brown on fracture surfaces (sample F11)	3
Clay, rusty brown, calcareous, slightly sandy; weathers reddish brown (sample F11)	2 6
Shale, dark blue-gray, well laminated, thin bedded, very slightly sandy (sample F11)	1 9
Clay, medium gray (sample F11)	1 6
Clay, light gray, slightly rusty brown along irregular joint surfaces; contains calcareous concretions in lower part (sample F11)	1 10
Limestone, reddish brown, weathered slightly porous and ferruginous (almost ironstone)	10-12
Clay, light gray, soft (sample F11)	3
Rock Island (No. 1) Coal; base not seen	1 6
Underclay, dark gray, shaly	10
Clay, light gray, shaly, sulfur stained (sample F12)	10
Clay, gray, rusty brown on fracture surfaces	10

Samples F116, F121, F126, F129, F130, F132, F135, F136, F138, F139, F140 - Composite section along ravine southwest Tarter Bridge in S½ sec. 2, T. 5 N., R. 1 E.

Pleistocene Series	
Loess and till	
Pennsylvanian System	
Carbondale Formation	

(FULTON COUNTY Cont.)	Thickness (Ft. In.)
Shale (Francis Creek), medium blue-gray, thick bedded, soft; contains ironstone concretions	20
Colchester (No. 2) Coal	2 8
Spoon Formation	
Underclay, gray, dense, earthy; contains irregular medium gray limestone concretions (sample F116)	3
Shale, gray, iron stained	6
Clay, gray, laminated, carbonaceous; contains plant impressions; locally coaly	2
Underclay, gray	1 6
Sandstone, medium to light gray, micaceous	0-6
Shale, medium blue-gray, silty; contains many irregularly bedded, gray limestone concretions in upper part	6
Greenbush Coal horizon	
Underclay, light gray, soft	8
Limestone, medium dark gray, dense, hard, in very irregular beds with rough iron-stained surfaces (sample F11)	6-18
Underclay, medium gray, finely sandy	1 6
Shale, black, clayey, soft (sample F121)	2
Wiley Coal; 1" clay parting near middle	6
Underclay, medium gray, iron stained	2-2½
Limestone (Seahorne), medium dark gray, fossiliferous, brecciated; has septarian structure; contains spalerite veinlets	6-18
Underclay, light gray, soft, iron stained	2
Sandstone, light gray, iron stained, fine grained, medium to thin bedded	2-3
Shale, light gray, soft, sandy	2 6
Shale, dark gray; contains fragmentary plant impressions	4
DeLong Coal	1½
Underclay, medium gray, silty	1 6
Clay, coaly	1
Underclay, gray (sample F126)	1 6
Coal	1
Underclay, light blue-gray, silty	2 8
Underclay, gray, iron stained, shaly	2 6
Shale, sandy, medium gray, iron stained, thick bedded, hard (sample F129)	4 6
Sandstone, gray, speckled brown, micaceous	6
Shale, medium dark blue-gray, well bedded (sample F130)	5
Shale, medium dark blue-gray, contains ironstone bands and concretions	2 6
Rock Island (No. 1) Coal	6
Underclay, medium gray; contains abundant root impressions; discontinuous	0-1
Abbott Formation	
Bernadotte Sandstone, light buff, massive and hard to thin bedded and soft, stigmarian	5 6
Shale, light to medium gray, soft	3
Pope Creek Coal	3-6
Underclay, light gray (sample F132)	3
Sandstone, buff, thin bedded	0-3½
Shale, dark gray, flaky; contains fossil leaves and small ironstone concretions	0-2½
Tarter Coal, strongly sulfur stained	1 1
Underclay, gray, sandy	2
Sandstone, gray	0-6
Shale, dark gray, flaky, ferruginous (sample F135)	2½ 6
Clay, dark gray (sample F136)	2½ 6
Manley Coal	1 6
Underclay, medium gray	8
Sandstone, light gray; contains root traces	1 11
Clay, medium gray, silty (sample F138)	3
Clay, light gray; contains joint fillings of light brownish gray, silty clay	2 6
Sandstone, yellowish to medium gray; quartz grains have secondary enlargement	4
Shale, dark gray to black, soft, flaky, ferruginous (sample F139)	1 2
Sandstone, gray, iron stained	7
Shale, dark gray to black, flaky above, slaty below, ferruginous; contains ironstone lenses (sample F140)	1 3
Coal	4
Sandstone, gray, iron stained, soft, structureless, stigmarian; thins against buried hills of St. Louis Limestone (exposed)	3-6
Mississippian System	
St. Louis Limestone	

Sample F152 - South side of tributary to Francis Creek in SW¼ NE¼ SW¼ sec. 22, T. 5 N., R. 1 E.

Pennsylvanian System	
Spoon Formation	
Coal "blossom"	2
Clay, light gray	1 6
Clay, gray, yellowish, slightly sandy	1 8
Clay, gray, sandy, blocky	10

(FULTON COUNTY Cont.)

	Thickness (Ft. In.)
Sandstone, gray, fine grained, slightly micaceous, in beds up to 1½", somewhat slabby	2
Shale, light gray to very dark gray (sample F152)	3
Clay, dark gray, weathered	2 6
Clay, light gray, rusty brown on fracture surfaces	2 6

Samples F165, F164, F163, F162, F161, F159, and F158 - East cutbank of creek in SW¼ SW¼ NE¼ sec. 19, T. 5 N., R. 2 E.

Pleistocene Series	
Loess and till	20
Pennsylvanian System	
Spoon Formation	
Clay, light gray, sandy (sample F156)	5
Clay, dark gray	1
DeLong Coal	1
Underclay, light to dark gray (sample 164)	1
Shale, gray, iron stained, clayey	1
Shale, light gray, clayey, sandy (sample F163)	5
Ironstone concretions in shale	3
Shale, light gray, clayey, sandy (sample F162)	3
Shale, dark gray, clayey, sandy (sample F162)	6
Shale, yellowish gray	6
Limestone, gray, argillaceous, nodular	0-6
Shale, dark gray to black near base, sandy (sample F161)	2 6
Hermon Coal	4
Sandstone, gray; contains plant remains; iron stained along joints; weathered to sandy clay at top	6
Shale, black, iron stained; contains coaly streaks and nodules of siderite (sample F159)	6
Rock Island (No. 1) Coal, sulfurous	1
Underclay; top few inches is dark gray; grades down to light gray; iron-stained joints surface (sample F158)	2

Samples F115 and F114 - Cutbank on south side of South Fork in SW¼ NE¼ NW¼ sec. 8, T. 6 N., R. 1 E.

Pleistocene Series	
Loess and till	
Pennsylvanian System	
Spoon Formation	
Clay, gray, weathered (sample F115)	8±
Shale, light gray (sample F114)	4
Limestone and ironstone concretions	4
Shale, black	3
Rock Island (No. 1) Coal	1/8
Clay, black	1
Clay, light gray	7
Clay, black, coaly	2
Coal	14
Underclay, gray	2
Abbott Formation	
Sandstone, gray (exposed)	3

HANCOCK COUNTY

Sample 992I - Southeast of bridge over La Harpe Creek in NE¼ SE¼ NE¼ sec. 33, T. 7 N., R. 5 W.

Pennsylvanian System	
Spoon Formation	
Clay, gray	2-3

Sample 992L - Tributary to main stream east of road in NE¼ SW¼ SE¼ sec. 1, T. 5 N., R. 5 W.

Pennsylvanian System	
Spoon or Abbott Formation	
Clay, gray	3±

Sample 992M - West bank of small stream south side of road in NW¼ NE¼ SE¼ sec. 13, T. 5 N., R. 5 W.

Pennsylvanian System	
Spoon Formation	
Clay, light gray (sample 992M)	2
Clay, gray, sandy (sample 992M)	2

Sample 992H - SE¼ NW¼ NW¼ sec. 13, T. 6 N., R. 5 W.

Spoon Formation (?)	
Shale, black; contains limestone lenses	3
Clay, gray, sandy (sample 992H)	10±
Abbott Formation (?)	
Sandstone	2±

Samples 992C, D, and E - East cutbank of Williams Creek in NW¼ SE¼ SW¼ sec. 26, T. 3 N., R. 5 W.

Pleistocene Series	
Loess	5-10
Pennsylvanian System	
Carbondale Formation	
Sandstone, massive, coarse, mealy	3-4
Shale, black, fissile, hard	1 3
Sandstone, gray, shaly, thin bedded	1 2
Shale, blue-gray, weathered rusty brown, fairly hard	2
Francis Creek Shale, light gray, soft, not evenly bedded	20±
Colchester (No. 2) Coal	2 3
Spoon Formation	
Clay, light gray; contains plant fossils (sample 992C)	1 10
Clay, light gray, sandy (sample 992C)	1 9

(HANCOCK COUNTY Cont.)

	Thickness (Ft. In.)
Sandstone, bluish to greenish gray, micaceous, moderately hard; contains carbonaceous matter	2 6
Clay, light gray, rusty brown on joint surfaces (sample 992D)	10
Clay, dark gray; irregular fracture (sample 992D)	3
Clay, light gray, harder than above (sample 992D)	6
Clay, dark gray (sample 992D)	2
Concealed interval	2
Clay, greenish gray (sample 992E) (exposed)	
Concealed interval	3
Limestone, red; contains concretions	4
Sandstone, brown	6
Shale, green-gray, sandy; contains calcareous concretions (exposed)	1

MC DONOUGH COUNTY

Sample 976MM - Stream bank in SW¼ SE¼ SW¼ sec. 17, T. 6 N., R. 2 W.

Recent - alluvium	2
Pennsylvanian System	
Spoon Formation (?)	
Clay, greenish gray (exposed)	4

Sample 976GG and HH - On east side of Argyle Creek in center SE¼ SE¼ sec. 36, T. 6 N., R. 4 W.

Pleistocene Series	
Loess and till	
Pennsylvanian System	
Spoon Formation	
Shale, yellowish gray (exposed)	3
Coal	1½
Underclay, gray	6
Shale, gray	4–5
Sandstone, gray	4
Shale, gray	6
Clay, gray, red stained	2–3
Clay, gray (sample 976HH)	7–8
Limestone, gray	1
Clay, gray (sample 976GG)	6
Shale, blue-gray; contains ironstone concretions (976GG)	6

Sample 976A - From underground mine in SW¼ SW¼ sec. 1, T. 5 N., R. 4 W.

Pennsylvanian System	
Spoon Formation	
Shale (roof of mine)	
Clay, gray (sample 976A)	6–7

Sample 976H - Clay pit in SW¼ NW¼ sec. 12, T. 5 N., R. 4 W.

Pleistocene Series	
Loess and till	
Pennsylvanian System	
Carbondale Formation	
Shale, yellowish gray, sandy, thinly bedded	10
Sandstone, yellow to white, massive	3–4
Shale, yellow-gray, sandy, coarsely laminated	15
Colchester (No. 2) Coal	18±
Spoon Formation	
Underclay, gray	3
Clay or shale, yellow-gray, sandy	4
Clay, gray	3
Shale, yellow-green, sandy	6
Clay, dark blue and purple at top, gray below	5
Sandstone, gray, thin bedded	2
Clay, black at top, gray below	1 3
Clay or shale, gray, clayey at top, shaly at bottom	8
Sandstone, gray, shaly, laminated	6
Clay, black at top grading to gray at bottom	2
Clay, black at top; grades into sandstone at base; from lower 6 feet (sample 976H)	10
Abbott Formation	
Sandstone, gray	30

Samples 976XX, YY, ZZ, AAA, BBB, CCC, and DDD - Abandoned clay pit in NW¼ SE¼ SW¼ sec. 11, T. 5 N., R. 4 W.

Pleistocene Series	
Loess and till	8±
Pennsylvanian System	
Carbondale Formation	
Francis Creek Shale, gray, rusty	16
Colchester (No. 2) Coal	3
Spoon Formation	
Underclay, dark gray, coaly (sample 976XX)	6
Underclay, light gray, (sample 976XX)	1 6
Underclay, gray, rusty brown (sample 976XX)	1
Clay, red, limy	2
Shale, gray (sample 976YY)	2 9
Clay, dark gray (sample 976ZZ)	11
Clay, gray, rusty brown; contains calcareous concretions (sample 976ZZ)	11
Seahorne Limestone, gray, knobby	3±
Clay, dark gray (sample 976AAA)	5
Clay, light gray, iron stained, shaly (sample 976BBB)	5
Ironstone band	2
Shale, light gray (sample 976CCC)	7±
Clay, gray, sandy (sample 976DDD)	1
Covered interval (sample 976DDD)	4±

(MC DONOUGH COUNTY Cont.)

	Thickness (Ft. In.)
Clay, black (sample 976DDD)	4
Rock Island (No. 1) Coal (sample 976DDD)	4
Underclay, gray	1
Underclay, gray, sandy (sample 976DDD)	2
Coal (sample 976DDD)	2
Underclay, gray, shaly, exposed (sample 976DDD)	1
Covered interval	7

Mississippian System
Limestone

Samples 976T and U - High wall in McClure mine in NE¼ NW¼ NW¼ sec. 11, T. 5 N., R. 4 W. The Pleistocene deposits have been stripped away.

Pennsylvanian System

Spoon Formation	
Seahorne Limestone	1
Clay, gray (sample 976U)	6
Shale, blue-gray	10
Sandstone	6
Clay-shale, gray	3
Sandstone	1
Clay at top grading to shale at base (sample 976T)	4
Rock Island (No. 1) Coal	3-18
Abbott Formation	
Sandstone	1
Sandy clay grading into clayey sandstone	4

Mississippian System
Limestone

Sample 976SS - East cutbank along south flowing ravine to Cedar Creek in W½ NW¼ SW¼ SW¼ sec. 6, T. 5 N., R. 4 W.

Pleistocene Series
Sand and cobbles, red 5

Pennsylvanian System

Spoon or Abbott Formation	
Clay, gray, sandy (sample 976SS)	3
Sandstone at water line	

Sample 976I - In creek west of old clay pit, center east line sec. 23, T. 5 N., R. 4 W.

Clay (exposed) 3 5

Sample 976WW - Road cut at turn of road in SW¼ NE¼ SE¼ sec. 6, T. 5 N., R. 3 E.

Pleistocene Series
Loess and till

Pennsylvanian System

Abbott or Spoon Formation	
Shale	
Coal streak	1
Underclay, dark gray	2
Limestone concretions	0-10
Clay, gray, sandy (sample 976WW) (exposed)	10

Samples 976AA and BB - 100 feet south of bridge near abandoned coal mine in NE¼ NE¼ NW¼ sec. 5., T. 5 N., R. 3 E.

Pleistocene Series

Pennsylvanian System

Spoon Formation	
Clay, gray, plastic (sample 976BB)	3
Clay, gray, blocky (sample 976AA)	3

Samples 976CC, DD, and EE - Along creek in SE¼ NE¼ NE¼ sec. 6, T. 5 N., R. 3 E.

Pleistocene Series
Loess and till

Pennsylvanian System

Spoon Formation	
Clay, light gray (sample 976CC)	3
Sandstone, white	1
Clay, gray, sandy (sample 976DD)	3 6
Shale, gray, micaceous (sample 976EE)	2 6
Shale, olive-gray	4±

SCHUYLER COUNTY

Samples 978 C, D, E, F, G, H, and I - East side of side road between bridge and paved road in SW¼ SW¼ SW¼ sec. 14, T. 3 N., R. 3 W.

Pleistocene Series
Loess 3±

Pennsylvanian System

Spoon Formation	
Clay, gray, sandy, calcareous along joints (sample 978C)	3
Clay, gray, very sandy; very thin coaly streaks (sample 978D)	1 3
Shale, gray, very sandy; thin coal streaks (sample 978D)	8
Shale, gray, sandy (sample 978E and 978F)	8
Shale, black, sandy (sample 978F)	6
Sandstone, gray	5
Shale, black, fissile	2½
Rock Island (No. 1) Coal (?)	
Coal	6
Clay, gray	2-3
Coal	6
Shale, gray, very sandy (sample 978G)	4
Shale, gray, very sandy; iron-stained joints (sample 978G)	1 6
Shale, dark gray; iron-stained joints (sample 978H)	3
Abbott Formation	
Sandstone, gray	5±
Shale, gray (sample 978I)	7

(SCHUYLER COUNTY Cont.)

	Thickness (Ft. In.)

Samples 978J, K, L, and M - Road cut in SE¼ SW¼ SW¼ sec. 10, T. 3 N., R. 1 W.

Pennsylvanian System

Spoon Formation

Shale, gray, sandy (sample 978J)	2	5
Shale, dark gray (sample 978K)		6
Clay-shale, light gray; iron-stained joints (sample 978K)	2	
Shale, sandy, gray; iron-stained joints (sample 978L)	2	
Coal		4
Limonite and clay	1	
Shale, black		4
Shale, gray (sample 978M)	3	
Clay, dark gray, coaly	1	

Abbott Formation

Sandstone

Samples 978GG, HH, II, JJ, and KK - Illinois Valley Brick and Tile Co. claypit at Frederick in sec. 17, T. 1 N., R. 1 E.

Pleistocene Series

Loess and till

Pennsylvanian System

Spoon or Abbott Formation

Shale, gray with red and yellow stains, very sandy (sample 978GG)	5	6
Shale, black (sample 978HH)	2	6
Shale, gray, sandy (sample 978II)	6	
Rock Island (No. 1) or Pope Creek Coal	1–2	6
Shale, gray, sandy (sample 978JJ)	7	
Shale, black, soft (sample 978KK)	1–2	

Sample 978FFF - Along creek south of Highway 101 in NE¼ NE¼ NW¼ sec. 23, T. 3 N., R. 3 W.

Pennsylvanian System

Spoon Formation or Abbott Formation

Sandstone	2	
Shale, gray (sample 978FFF)	5	
Shale, black, fissile, laminated; contains sandy shale	2	3
Coal		10±
Underclay		4
Sandstone	2	6

WARREN COUNTY

Samples 977C, 977D, 977B, 977A - Cutbank on SW side of ravine south of road bridge in NE¼ NE¼ SW¼ sec. 15, T. 11 N., R. 2 W.

Pleistocene Series

Loess and drift

Pennsylvanian System

Spoon Formation

Coal and coaly clay (sample 977C)	½
Clay, yellow-gray (sample 977C)	2
Clay, coaly (sample 977C)	¼
Clay, light gray grading to gray (sample 977C)	5
Coal, soft, bony (sample 977C)	1½
Clay, light to purplish gray, blocky, sandy (sample 977C)	2
Clay, purplish to dark gray, shaly, at base (sample 977C)	6
Shale, blue-gray, soft, thin bedded (sample 977D)	4
Clay, bluish gray, shaly (sample 977B)	2
Sandstone, bluish gray, fine grained (sample 977B)	4
Rock Island (No. 1) Coal	
Coal	9½
Clay, blue	1½
Coal	11
Clay, dark gray to black (sample 977A)	4
Clay, light gray, sandy (sample 977A)	1 5
Clay, medium blue-gray, silty (sample 977A)	1½–2

Abbott Formation

Shale, dark blue-gray, sandy (sample 977A)	1
Sandstone	2

Samples 977F, G, H, I, and J - South bank of creek east of bridge in NW¼ NW¼ SE¼ sec. 11, T. 9 N., R. 2 W.

Pleistocene Series

Loess and till

Pennsylvanian System

Spoon Formation

Clay, gray, stained yellow (sample 977F)	1	6
Clay, light gray (sample 977G)	1	6
Clay, gray, stained yellow (sample 977H)	1	6
Clay, dark gray (sample 977I)	1	
Sandstone		1½
Clay, dark gray (sample 977J) (exposed)	1	6

NOTES ON AREAS EXAMINED BUT NOT SAMPLED

In the area around Camp Point in Adams County, 8 feet of clay is exposed along the tributary to South Fork of Bear Creek in SW¼ NE¼ sec. 16, T. 1 N., R. 6 W., and 4 feet of clay is exposed west of the road along South Fork of Bear Creek in NE¼ NE¼ sec. 17 of the same township. This clay is in the Spoon Formation.

An area along Coal Creek in the W½ NW¼ sec. 20, T. 2 S., R. 5 W., Adams County, would have several acres with thin overburden unless the stream has eroded the clay. This could be determined only by drilling.

In Liberty Township in Adams County, 1½ feet of clay is exposed at the center of the south line SE¼ sec. 29, R. 2 S., R. 6 W. This clay is in the Spoon Formation.

In Beverly Township in Adams County, 8 feet of clay is exposed along a small tributary to Fishhook Creek in NE¼ NE¼ sec. 3, T. 3 S., R. 5 W. Three feet of clay is also exposed in NW¼ SW¼ of the same section. In SE¼ SW¼ sec. 11 of the same township, 4 feet of clay is exposed along a tributary to Fishhook Creek. These clays are in the Spoon Formation.

Most of the eastern half of Adams County is underlain by the clay between the Colchester (No. 2) Coal and the base of the Pennsylvanian. On the outcrop there is one and sometimes two gypsum zones that possibly represent limestones in the unweathered clay back from the outcrop.

North of the creek in SE¼ NE¼ NE¼ sec. 14, T. 1 N., R. 3 W., Brown County, about 5 feet of clay crops out in the road. As the clay was badly weathered and was mixed with other material, a sample was not taken. If the clay is five feet thick, several acres of clay may be present.

In NE¼ NE¼ SW¼ sec. 34, T. 1 N., R. 3 W., Brown County, in a roadcut on the west side of the road along the north valley wall of the creek, 45 inches of light gray, iron-stained clay with an abundance of large gypsum crystals is exposed beneath Pleistocene material.

By drilling in the S½ SE¼ sec. 36, T. 1 N., R. 3 W., Brown County, clay similar to 990F sample might be found and the overburden would probably not be too thick for stripping.

There were no outcrops in Henderson County, but well logs indicate that the Spoon and Abbott Formations underlie Pleistocene deposits in the southeast corner of Henderson County as shown in figure 3.

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